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Walker

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(54) **SURVEILLANCE IMAGING SYSTEM AND METHOD**

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(22) Filed: **Dec. 17, 2015**

(51) **Int. Cl.**

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G06T 7/20	(2017.01)
B64C 39/02	(2006.01)
H04N 5/247	(2006.01)
G06T 7/00	(2017.01)

(52) **U.S. Cl.**
CPC ***G06T 7/2093*** (2013.01); ***B64C 39/024*** (2013.01); ***G06T 7/004*** (2013.01); ***H04N 5/247*** (2013.01); *B64C 2201/024* (2013.01); *B64C 2201/123* (2013.01); *B64C 2201/141* (2013.01); *G06T 2207/10016* (2013.01); *G06T 2207/10032* (2013.01); *G06T 2207/20092* (2013.01); *G06T 2207/30241* (2013.01)

(58) **Field of Classification Search**
CPC combination set(s) only.
See application file for complete search history.

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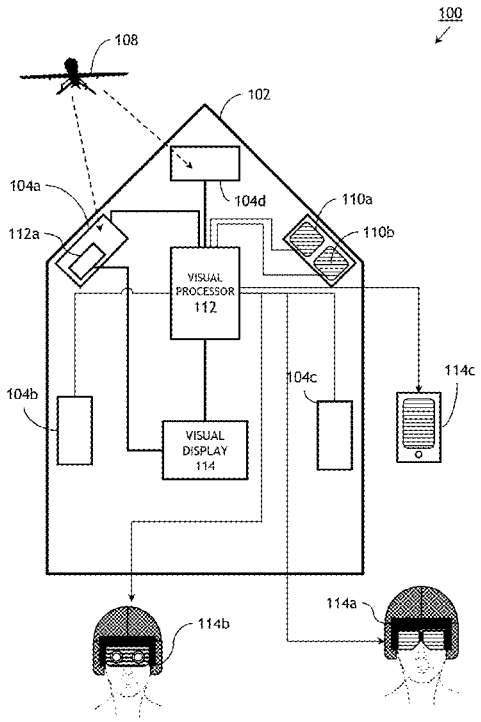
(57) **ABSTRACT**

A system and related method for detecting unmanned aerial vehicles and other targets aboard an aircraft scans a region proximal to the aircraft with a network of image sensors attached to the aircraft exterior. Visual processors detect potential targets and determine location data associated with the targets based on the captured images, sending the captured images and associated location data to a visual display system for display to a pilot or crew of the aircraft along with cueing symbology. The visual display system may include a cockpit-mounted heads-down display, a monocular, binocular, or head-tracking helmet-mounted display, or an offboard mobile device. The system may scan a 3-D space around the aircraft or a proximal 2-D section of terrain.

19 Claims, 7 Drawing Sheets



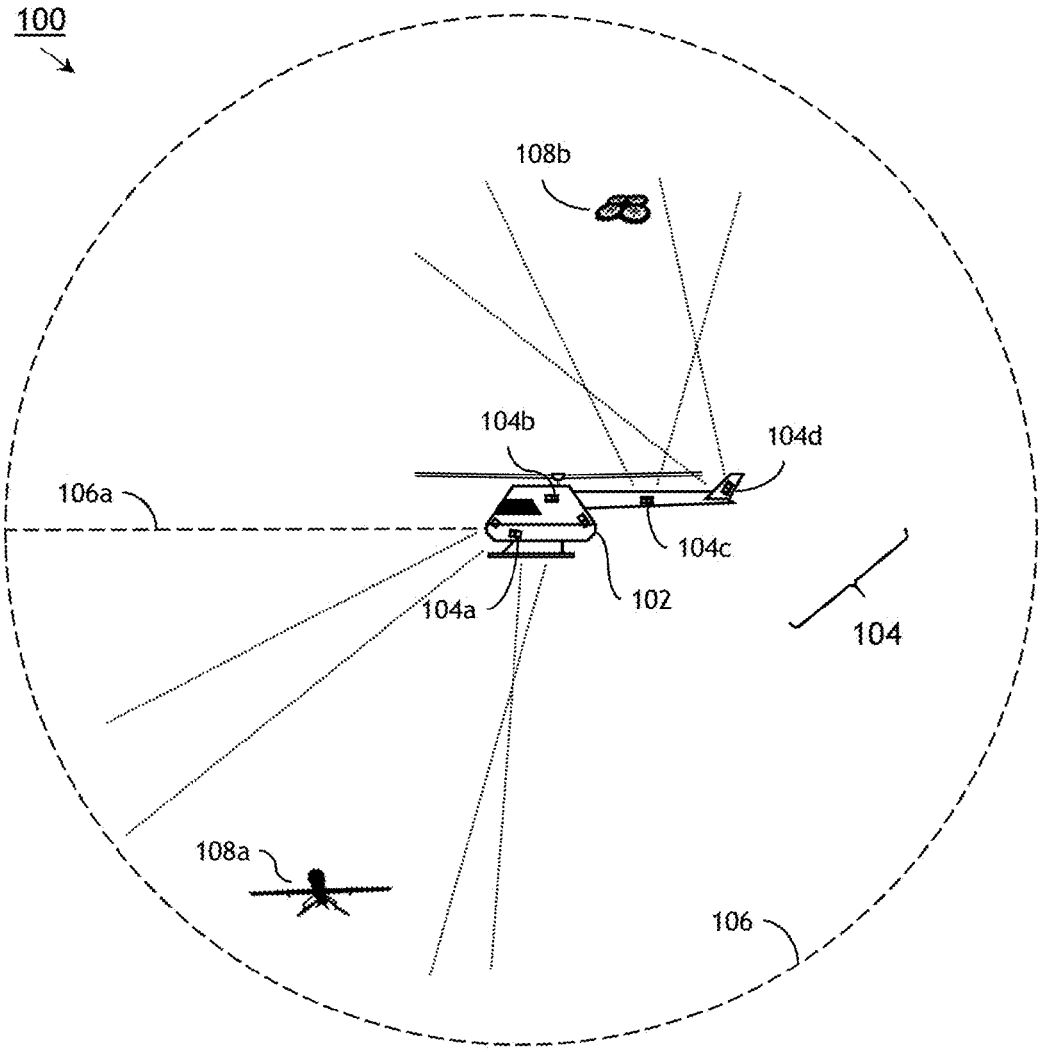


FIG. 1

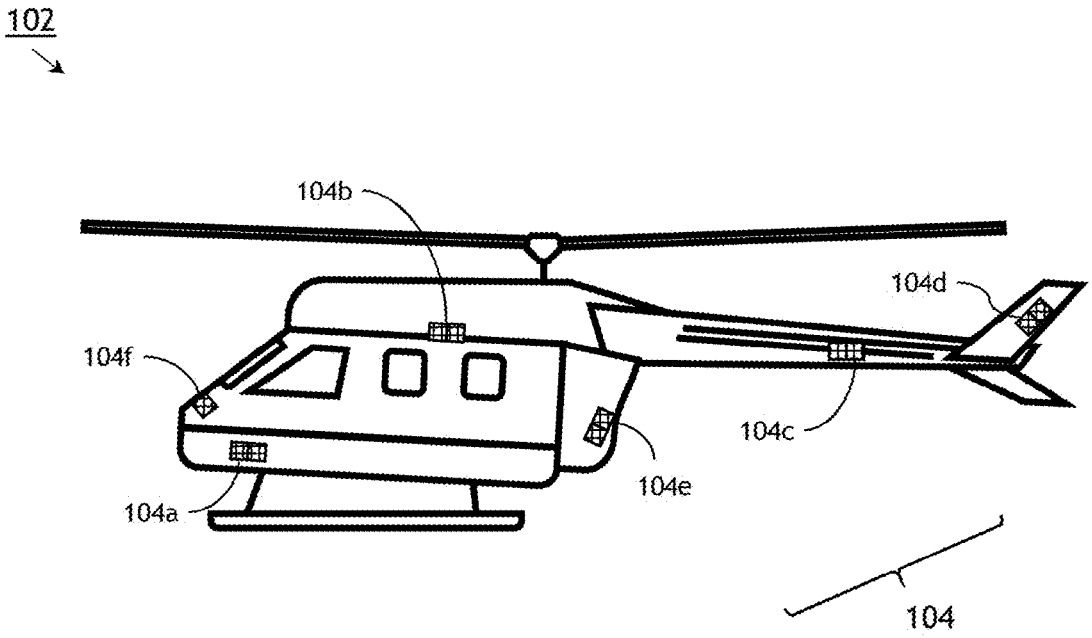


FIG. 2A

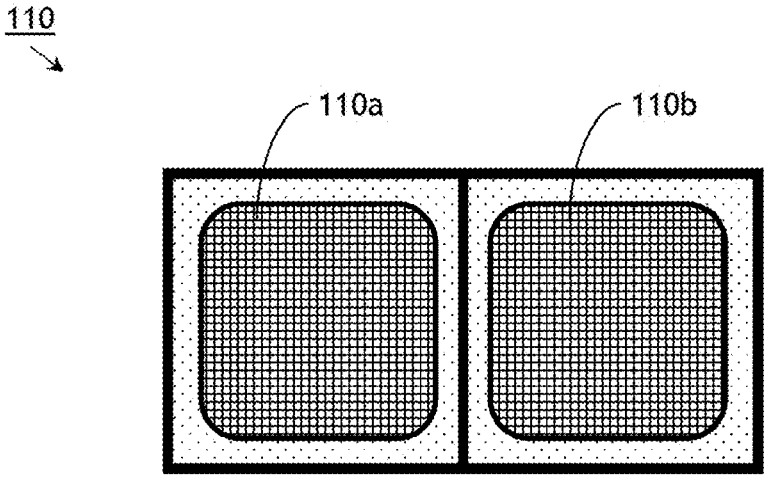


FIG. 2B

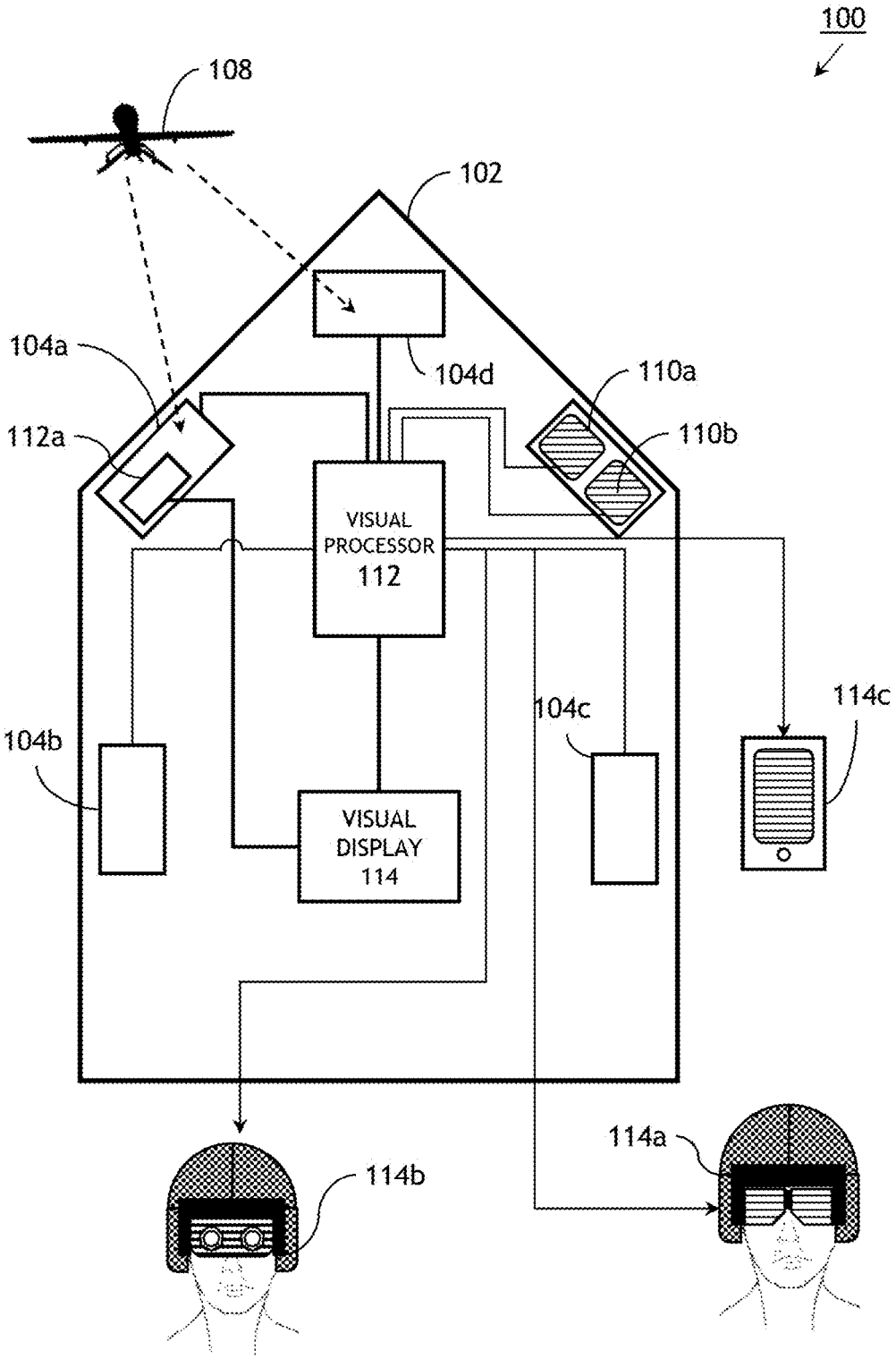

100
108
102
104a
104d
110a
112a
110b
VISUAL PROCESSOR 112
104b
104c
114c
VISUAL DISPLAY 114
114a
114b

FIG. 3

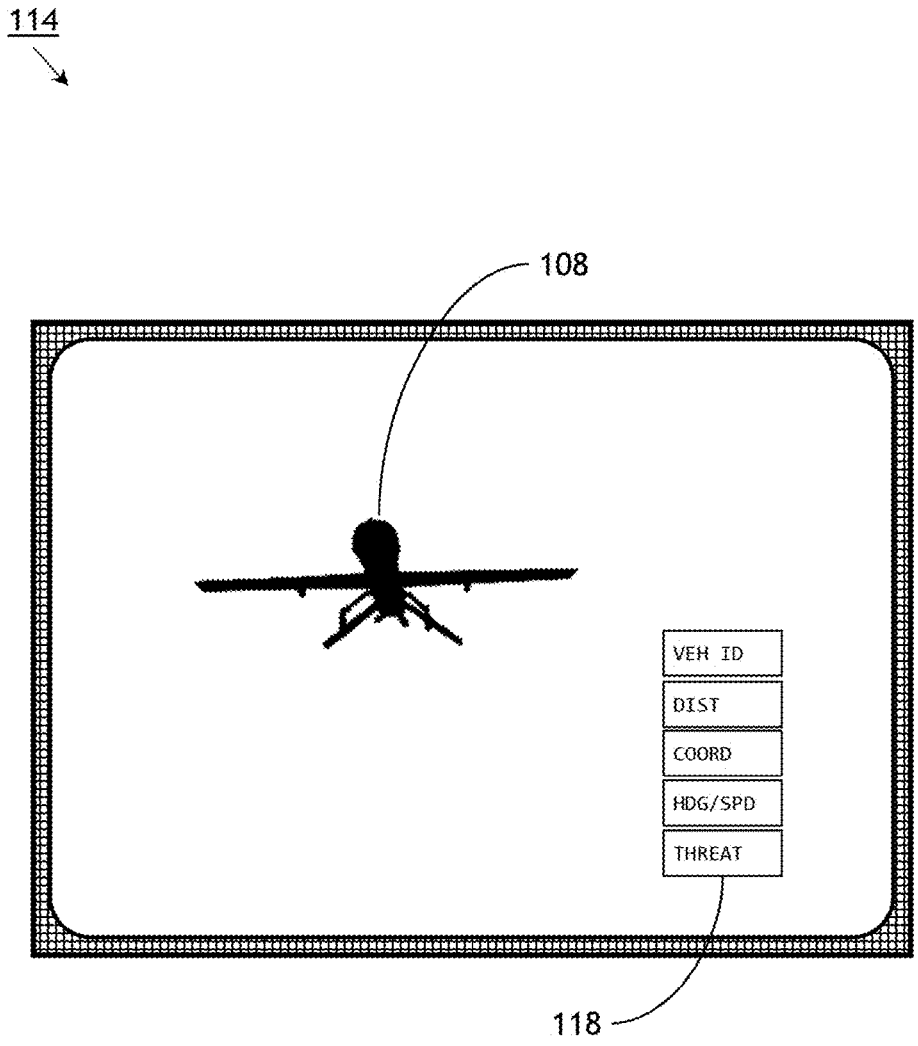


FIG. 4

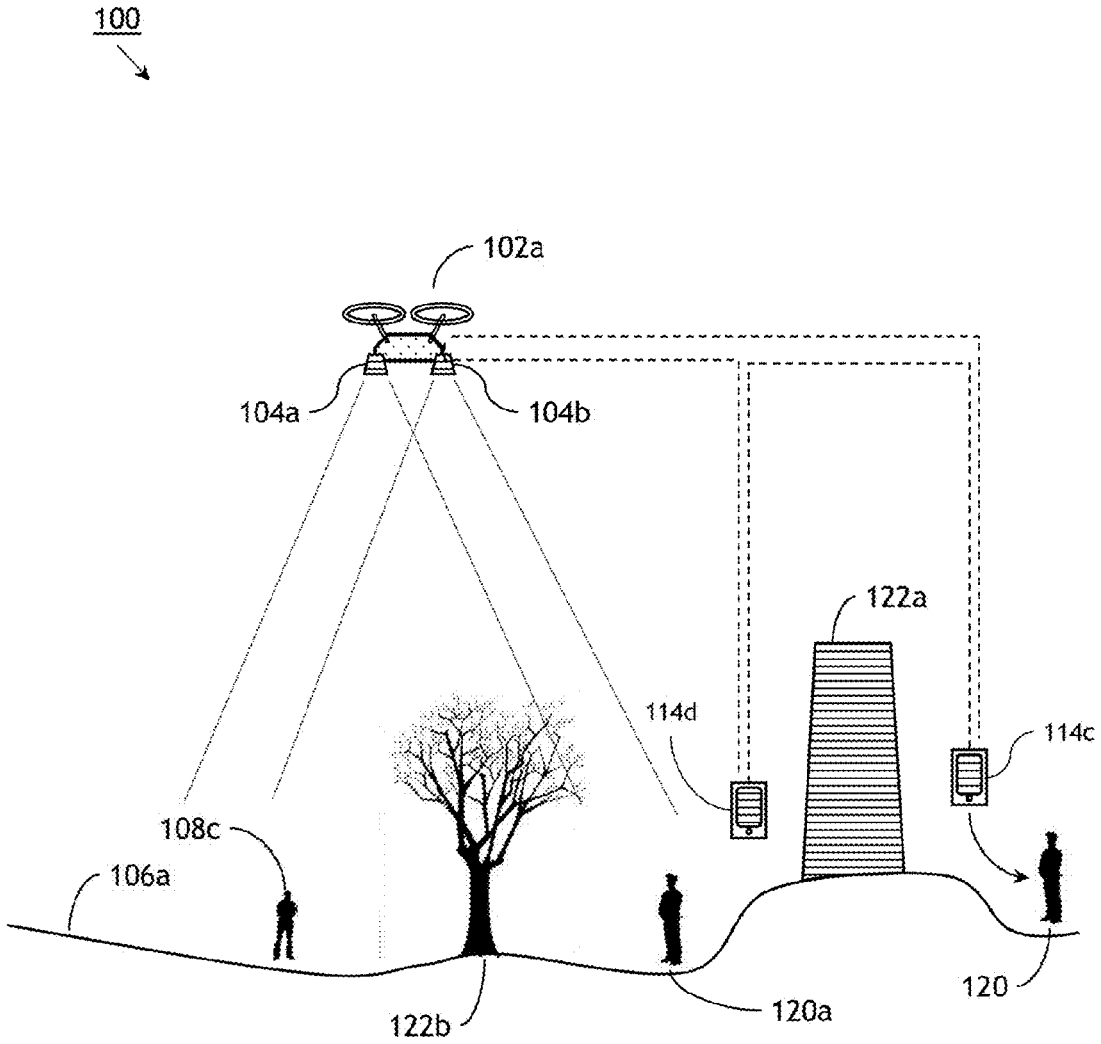


FIG. 5A

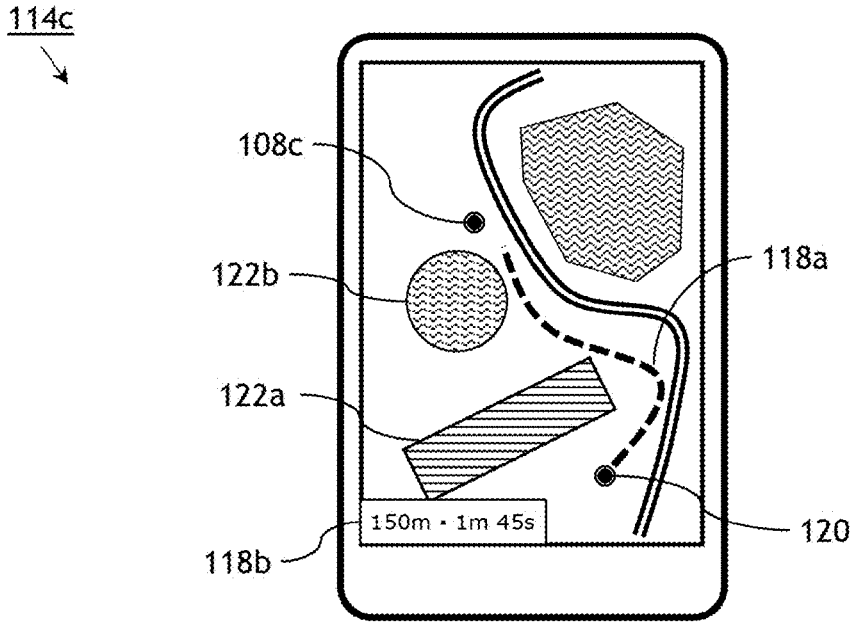

114c
108c
122b
118a
122a
150m • 1m 45s
120
118b

FIG. 5B

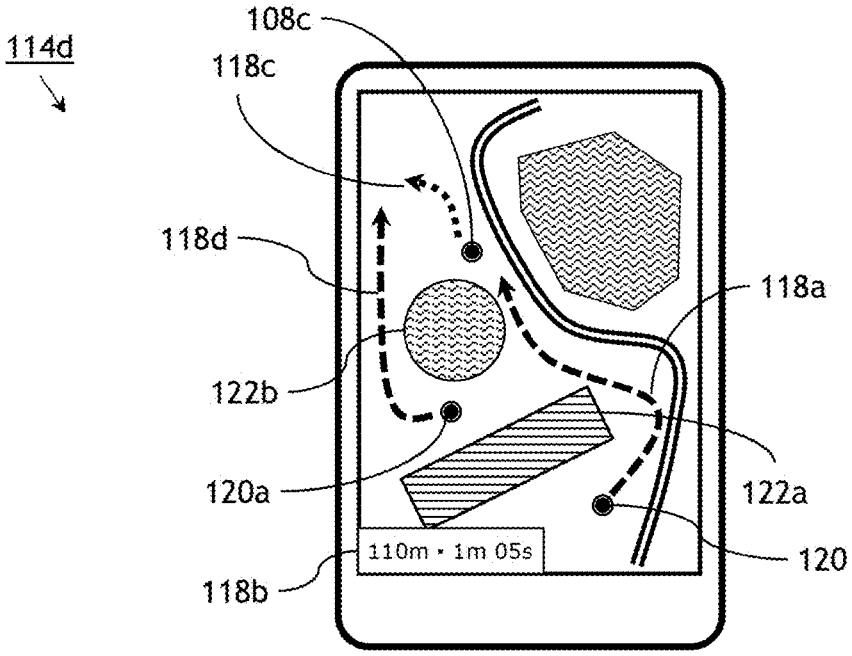

114d
108c
118c
118d
118a
122b
120a
122a
110m • 1m 05s
120
118b

FIG. 5C

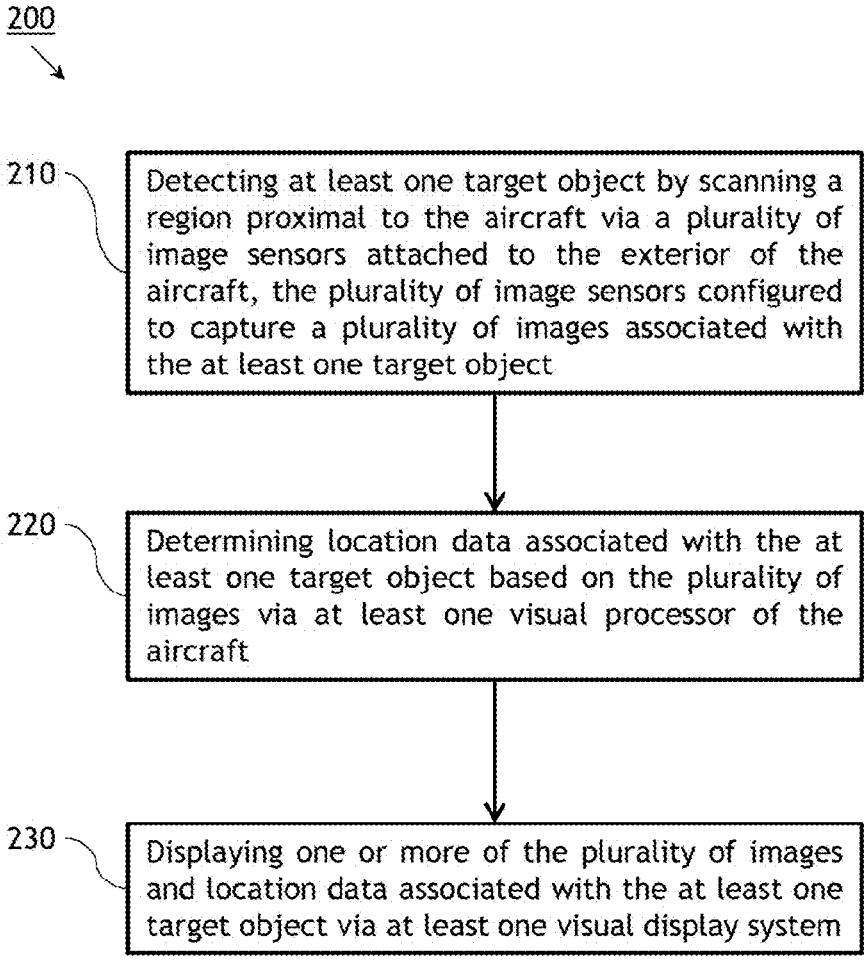

200
210
Detecting at least one target object by scanning a region proximal to the aircraft via a plurality of image sensors attached to the exterior of the aircraft, the plurality of image sensors configured to capture a plurality of images associated with the at least one target object
220
Determining location data associated with the at least one target object based on the plurality of images via at least one visual processor of the aircraft
230
Displaying one or more of the plurality of images and location data associated with the at least one target object via at least one visual display system

FIG. 6

SURVEILLANCE IMAGING SYSTEM AND METHOD

BACKGROUND

Unmanned aerial vehicles (UAV) such as drones or multi-rotor vehicles (e.g., quadcopters, hexacopters, octocopters and the like) pose a significant threat to military and commercial aircraft alike. For example, most consumer grade UAVs do not carry transponders and are therefore undetectable by secondary surveillance radar (SSR) or automatic dependent surveillance-broadcast (ADS-B) systems. A pilot may generally detect a UAV proximal to the aircraft only via unaided visual recognition, which may be difficult even under the best of visibility or atmospheric conditions due to the small size of the UAV. Even if a pilot is able to visually detect a threatening UAV (one proximal to, on a collision course with, or otherwise capable of damaging the aircraft), eliminating the threat may only be as effective a tactic as the pilot's ability to guess at the exact position of the UAV.

SUMMARY

In one aspect, embodiments of the inventive concepts disclosed herein are directed to an aircraft-based system for detecting and targeting unmanned aerial vehicles (UAV) and similar airborne targets, and sending the coordinates of those targets to an onboard or offboard visual display system. The system may employ a network of image sensors arranged over the exterior of the aircraft to capture a series of images by scanning a region proximal to the aircraft, employing visual and pattern recognition to detect potential targets based on the captured images. The system may display the captured images to the pilot for visual validation or active selection of a potential target.

Once a target has been detected, the system determines the coordinates of the target and sends the captured images and coordinates to a visual display system, which may display images of the target and other pertinent information to the pilot via a cockpit-mounted display or a helmet-mounted display. The system may include a second UAV equipped with one or more cameras and configured to scan a section of terrain underneath the UAV to detect persons or other moving targets, determine the locations of those targets, and display the captured imagery and location data via an offboard mobile device carried by a soldier or law enforcement professional in pursuit of the moving target.

In a first aspect, the system may include a network of image sensors attached to the exterior of the aircraft and configured to capture a series of images by scanning a region around the aircraft. The system may include visual processors configured to determine the dimensions of the scanned region and detect a target object within the region based on the captured images. The visual processors may generate location data associated with the target object based on the captured images and forward the captured images and location data to a visual display system. The visual display system may display the captured images and location data.

In a further aspect, the inventive concepts disclosed herein are directed to a system wherein the visual processors are configured to display the captured images and select a target object based on input provided by a pilot via the visual display system.

In a further aspect, the inventive concepts disclosed herein are directed to a system wherein the visual processors determine a distance, inertial coordinates, or georeferenced coordinates of the target object based on the captured images.

In a further aspect, the inventive concepts disclosed herein are directed to a system wherein the visual processors determine a velocity, a heading, or a future position of the target object based on the captured images.

In a further aspect, the inventive concepts disclosed herein are directed to a system wherein the scanned region includes a three-dimensional space and a two-dimensional section of terrain.

In a further aspect, the inventive concepts disclosed herein are directed to a system wherein the target object includes an unmanned aerial vehicle (UAV).

In a further aspect, the inventive concepts disclosed herein are directed to a system wherein the image sensors include visible light image sensors, infrared image sensors, ultraviolet image sensors, and stereo paired image sensors.

In a further aspect, the inventive concepts disclosed herein are directed to a system wherein the image sensors include at least a first image sensor at a first location on the exterior surface of the aircraft and a second image sensor at a second location on the exterior surface of the aircraft.

In a further aspect, the inventive concepts disclosed herein are directed to a system wherein the visual processors are incorporated into one or more of the plurality of image sensors.

In a further aspect, the inventive concepts disclosed herein are directed to a system wherein the visual display system includes a heads-down display (HDD), a helmet-mounted display (HMD), a multispectral fusion display system, a head-tracking display system, and an offboard mobile device.

In a further aspect, the inventive concepts disclosed herein are directed to a system wherein the visual display system is configured for picture-in-picture display, digital zoom of the captured images, or the display of symbology associated with the captured images, the location data, or the target object.

In a further aspect, the inventive concepts disclosed herein are directed to a system wherein the displayed symbology includes a threat assessment, a mapping detail, an identifier of the target object, and a route to a location of a target object.

In a still further aspect, the inventive concepts disclosed herein are directed to a method for detecting a target object via an aircraft-based system. The method may include detecting the target object by scanning a region proximal to the aircraft via a network of image sensors attached to the aircraft exterior, the image sensors configured to capture a series of images associated with the target object. The method may include determining location data associated with the target object based on the captured images via visual processors. The method may include displaying the captured images and location data via a visual display system.

In a further aspect, the inventive concepts disclosed herein are directed to a method further including displaying the captured images to a user via the visual display system and selecting the target object based on input from the user through the visual display system.

In a further aspect, the inventive concepts disclosed herein are directed to a method further including detecting the target object by scanning a section of terrain proximal to the aircraft.

In a further aspect, the inventive concepts disclosed herein are directed to a method further including determining a

distance, inertial coordinates, georeferenced coordinates, a velocity, a heading, and a future position of the target object based on the captured images.

In a further aspect, the inventive concepts disclosed herein are directed to a method further including displaying the captured images and associated location data via a heads-down display (HDD), a helmet-mounted display (HMD), and an offboard mobile device.

In a further aspect, the inventive concepts disclosed herein are directed to a method further including displaying the captured images and location data via a head-tracking HMD.

In a further aspect, the inventive concepts disclosed herein are directed to a method further including displaying symbology associated with the captured images, the location data, or the target object via the visual display system. The symbology may include a threat assessment, a mapping detail, an identifier of the target object, and a route to a location of the target object.

BRIEF DESCRIPTION OF THE DRAWINGS

The inventive concepts disclosed herein may be better understood by those skilled in the art by reference to the accompanying figures in which:

FIG. **1** is a diagrammatic illustration of a system according to embodiments of the inventive concepts disclosed herein;

FIG. **2**A is an illustration of an aircraft according to embodiments of the inventive concepts disclosed herein;

FIG. **2**B is an illustration of an image sensor according to embodiments of the inventive concepts disclosed herein;

FIG. **3** is a block diagram of a system according to embodiments of the inventive concepts disclosed herein;

FIG. **4** is a diagrammatic illustration of a visual display system according to embodiments of the inventive concepts disclosed herein;

FIG. **5**A is a diagrammatic illustration of a system according to embodiments of the inventive concepts disclosed herein;

FIGS. **5**B and **5**C are illustrations of a visual display system according to embodiments of the inventive concepts disclosed herein; and

FIG. **6** is a process flow diagram illustrating a method according to embodiments of the inventive concepts disclosed herein.

DETAILED DESCRIPTION

Features of the inventive concepts disclosed herein in their various embodiments are exemplified by the following descriptions with reference to the accompanying drawings, which describe the inventive concepts with further detail. It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not necessarily restrictive of the inventive concepts disclosed and claimed herein. These drawings depict only exemplary embodiments of the inventive concepts, and should not be considered to limit their scope in any way.

Embodiments of the inventive concepts disclosed herein are directed to a system and related method for detecting airborne targets via a network of image sensors aboard an aircraft and determining the location of detected targets based on captured images. The captured images and location data are displayed aboard the aircraft by a visual display system, or to a remote user via an offboard mobile device.

Referring to FIG. **1**, a system **100** for target detection aboard an aircraft according to embodiments of the inventive concepts disclosed herein is shown. An aircraft **102** may be equipped with a network of image sensors **104***a-f* attached to, or positioned on, the exterior of the aircraft **102**. The network of image sensors **1-4***a-f* may include any desired number of sensors **104** which are collectively configured to capture an image or stream of images associated with any point in line of sight within a scanning region **106** surrounding the aircraft **102**. The scanning region **106** may include a spherical region defined by a predetermined radius **106***a*, the radius **106***a* set by a control system of the aircraft **102**, or any appropriate three-dimensional region proximal to the aircraft **102**. The network of image sensors **104***a-f* may identify potential targets **108***a-b* within the scanning region **106** based on captured images including the potential targets **108***a-b*. For example, the potential target **108***a* may lie within the scanning region **106** and within the fields of vision of individual image sensors **104***a* and **104***b*. Similarly, the potential target **108***b* may lie within the field of vision of image sensors **104***c* and **104***d*.

Referring to FIG. **2**A, the aircraft **102** may be implemented as a helicopter or other rotary aircraft, a fixed-wing aircraft, or an unmanned aerial vehicle (UAV). The network of image sensors **104***a-f* may include single visible light sensors, infrared light sensors, and image sensors with integrated visual processors. The network of image sensors **104***a-f* may be arranged about the exterior of the aircraft **102** such that every point within the scanning region **106** (FIG. **1**) surrounding the aircraft **102** remains in line of sight of at least one image sensor **104***a-f*, and optimally two or more image sensors **104***a-f*. For example, the network of image sensors **104***a-f* may include an image sensor **104***a* in a port forward position on the exterior of the aircraft **102**; an image sensor **104***b* in a port midship position; an image sensor **104***c* in a port boom position; an image sensor **104***d* in a port tail position; an image sensor **104***e* in a port aft position; and a forward-mounted image sensor **104***f*. The starboard side (not shown) of the aircraft **102** may include a complementary arrangement of image sensors **104***a-f*; the precise placement of image sensors **104***a-f* may vary with the configuration of the aircraft **102**. Referring also to FIG. **2**B, the network of image sensors **104***a-f* may include a stereo paired image sensor **110** including two image sensors **110***a*, **110***b* configured to capture images from minimally differing perspectives (e.g., situated at a relatively small distance from each other compared to the image sensors **104***a*, **104***d* situated at opposite ends of the aircraft **102**) that may be combined to simulate a stereoptic perspective.

Referring to FIG. **3**, a block diagram of the system **100** of FIG. **1** is shown. The network of image sensors **104***a-e* (which may include stereo-paired image sensors **110***a* and **110***b*) may be distributed throughout the exterior of the aircraft **102**. When a target **108** (including a potential target) comes within the line of sight of one or more image sensors **104***a-f*, visual processors **112** onboard the aircraft **102** may determine whether the target **108** constitutes a legitimate target and, if so, determine location data associated with the target **108** based on the images captured by the image sensors **104***a-f*. The visual processors **112** may include or incorporate existing aircraft processing systems, or visual processing may be performed by integrated visual processors **112***a* incorporated into an image sensor **104***a*, which then forwards determined location data and the captured images to a visual display system **114** of the aircraft **102**. Visual processors **112** may employ pattern recognition algorithms and other strategies to determine whether a target **108**

presents a shape, a heading, a size, a thermal signature, or other characteristics associated with a valid or confirmed target. The visual processors **112** may forward captured images to the visual display system **114** for display to a pilot or crewmember of the aircraft **102**, determining whether the target **108** is a valid target based on the pilot's visual evaluation and validation of the target.

When the system **100** identifies a target **108** based on images captured by the image sensors **104***a-f*, and the target **108** is confirmed as a valid target (e.g., an unmanned aerial vehicle or similar hostile object), the visual processors **112** may determine location data associated with the target **108**. For example, the visual processors may determine a distance of the aircraft **102** to the potential target **108** and positional (e.g., Cartesian, inertial) coordinates corresponding to the location of the potential target **108** based on epipolar geometry. The visual processors **112** may determine absolute or georeferenced coordinates (e.g., GPS coordinates) of the target **108** based on the captured images, the determined distance, and the determined positional coordinates of the target **108**. The visual processors **112** may employ Kalman filtering, optical flow analysis, or similar strategies to infer a future state of the target **108**. For example, the visual processors **112** may infer a future position, a velocity, a rate of acceleration, or a heading of the target **108**.

Images associated with the target **108** (and captured by the image sensors **104***a,d*) may be forwarded along with determined location data associated with the target **108** to the visual display system **114** for display to the pilot or crew of the aircraft **102**. The visual display system **114** may include a cockpit-mounted heads-down display (HDD) or a (binocular or monocular) helmet-mounted display **114***a* (HMD) worn by the pilot or crewmember. The visual display system **114** may include additional features for enhancement of visual intelligence, such as picture-in-picture display or digital zoom capability. The HMD **114***a* may include a night-vision HMD **114***b* configured for use in darkness, adverse weather, or other types of degraded visual environment (DVE). Targeting imagery associated with a three-dimensional scanning region (**106**, FIG. **1**) may be presented to the pilot by the visual display system **114** in a format providing for depth perception. For example, if the pilot is not equipped with an HMD **114***a*, the pilot's helmet visor may be equipped with polarizing filters configured to provide depth perception in conjunction with a HDD of the visual display system **114**. A visual display system **114** including an HMD **114***a* may employ head-tracking to present visual information and location data associated with a target **108** spherically. For example, the HMD **114***a* may display captured images associated with the target **108** if the pilot wearing the HMD **114***a* is looking in the appropriate direction, regardless of whether the pilot has a clear visual line of sight to the target **108** (e.g., "see-through helicopter"), and shift the displayed imagery based on the pilot's head movements. The visual display system **114** may further include an offboard mobile device **114***c* such as a tablet, smartphone, or other portable computing device.

Referring to FIG. **4**, a simulation of the visual information and location data displayed by the visual display system **114** is shown. The visual display system **114** may display captured images associated with a target **108** (e.g., via HDD, via HMD, via mobile device) as well as location data determined by the visual processors (not shown) and presented to the pilot or crew in the form of cues or symbology **118**. For example, symbology **118** displayed by the visual display system **114** may include a distance, coordinates, heading, velocity, thermal signature, identifier, or threat assessment of the target **108**. The visual display system **114** may include a multispectral fusion display system capable of simultaneously displaying visual intelligence associated with the target **108** as well as thermal intelligence associated with the target **108** and captured by infrared or other thermal imaging sensors of the system **100**. Symbology **118** may include visual enhancements or mapping details of the environment surrounding the target **118** such as an artificial horizon.

Referring to FIGS. **5**A and **5**B, in some embodiments of the inventive concepts disclosed herein, the aircraft may be an unmanned aerial vehicle **102***a*, the scanning region may include a two-dimensional section of terrain **106***a* proximal to the UAV **102***a*, and the target may include a target individual **108***c* being pursued by a soldier, law enforcement professional, or other similar user **120** of the system **100**. For example, the user **120** may carry a mobile device **114***c* configured as a visual display unit of the system **100**. The user **120** may not have a clear line of sight to the target individual **108***c* due to the presence of obstacles **122**, or his/her knowledge of the surrounding terrain **106***a* may be limited by unfamiliarity with the terrain or by DVE conditions. The UAV **102***a* may be equipped with one or more image sensors **104***a-b* (including visible-light, ultraviolet, or thermal imaging sensors) configured to scan the section of terrain **106***a* designated by the system **100** and capture images of the section of terrain **106***a* to evaluate any objects within the field of vision of the image sensors **104***a-b*.

Visual processing of the captured images may be performed by visual processors of the system **100** (not shown) aboard the UAV **102***a*, or the captured images may be streamed to the mobile device **114***c* carried by the user for evaluation and display. For example, the system **100** may identify the target individual **108***c* within the section of terrain **106***a* based on shape, movement, or thermal signature and determine the coordinates of the target individual **108***c*.

Referring particularly to FIG. **5**B, the mobile device **114***c* may display images associated with the target individual **108***c* along with determined location data in the form of symbology **118**. For example, having identified the location (e.g., georeferenced coordinates) of the target individual **108***c*, the mobile device **114***c* may determine the coordinates of the user **120** based on an onboard GPS receiver or position sensor and display imagery associated with the section of terrain **106***a* along with the relative locations of the user **120** and target individual **108***c*, showing any terrain characteristics (such as obstacles **122***a-b*) identified by visual processing or location-based metadata (e.g., by cross-referencing images and location data with existing terrain databases). The mobile device **114***c* may further display symbology corresponding to a recommended route **118***a* to the target individual **108***c* (based on available mapping and terrain information) and a projected distance and time to intercept (**118***b*) the target individual **108***c* based on the recommended route **118***a*.

Referring back to FIG. **5**A, an offboard system of the system **100** may include a second mobile device **114***d* carried by a second user **120***a* (e.g., an additional law enforcement professional or soldier). Referring also to FIG. **5**C, the system **100** may infer a heading (**118***c*) or future position of the target individual **108***c*. For example, assuming the user **120** follows the recommended route **118***a* to reach the target individual **108***c*, the target individual **108***c* may most likely follow the heading **118***c*. If the second user **120***a*, carrying the mobile device **114***d*, is in a position to intercept the target individual **108***c*, the system **100** may send captured images and the recommended route **118***a* (for

the user **120**) to the second mobile device **114***d* of the second user **120***a*, along with the projected heading **118***c* of the target individual **108***c* and a recommended intercept route **118***d* by which the second user **120***a* may most likely intercept the target individual **108***c* in the shortest amount of time or via the shortest distance. The mobile device **114***c* of the first user **120** may display the projected heading **118***c* of the target individual **108***c* as well as the position (and the recommended intercept route **118***d*) of the second user **120***a*, so that the two users **120**, **120***a* may coordinate their pursuit of the target individual **108***c*.

Referring to FIG. **6**, a process flow diagram illustrating a method **200** for detecting at least one target object **108** aboard an aircraft **102** is shown. At a step **210**, the method **200** detects a target by scanning a region proximal to an aircraft via a network of image sensors attached to the exterior of the aircraft, the network of image sensors configured to capture a series of images associated with the target. For example, a visual display system may display the captured images to a pilot of the aircraft and select a target from the captured images based on input from the pilot. The image sensors may scan a region proximal to the aircraft with at least a first image sensor configured to capture a first image and a second image sensor configured to capture a second image.

At a step **220**, the method **200** determines location data associated with the target based on the captured images via a visual processor of the aircraft. For example, the visual processors may determine a distance of the target, inertial coordinates of the target, georeferenced coordinates of the target, a velocity of the target, a heading of the target, and a future position of the target via the captured image.

At a step **230**, the method **200** displays the captured images and determined location data associated with the target via a visual display system. For example, the visual display system may display the captured images and determined location data associated with the target via a heads-down display (HDD), a helmet-mounted display (HMD), or an offboard mobile device. The HMD may include a night-vision HMD and a head-tracking HMD. The visual display system may additionally display symbology associated with the captured images, the determined location data, or the target including a threat assessment, a map detail, an identifier of the target, and a route to a location of the target.

CONCLUSION

Specific blocks, sections, devices, functions, processes, and modules may have been set forth. However, a skilled technologist will realize that there are many ways to partition the system, and that there are many parts, components, processes, modules or functions that may be substituted for those listed above.

Those having skill in the art will recognize that the state of the art has progressed to the point where there may be little distinction left between hardware, software, and/or firmware implementations of aspects of systems; the use of hardware, software, and/or firmware is generally (but not always, in that in certain contexts the choice between hardware and software can become significant) a design choice representing cost vs. efficiency tradeoffs.

Additionally, implementations of embodiments disclosed herein may include executing a special-purpose instruction sequence or invoking circuitry for enabling, triggering, coordinating, requesting, or otherwise causing one or more occurrences of virtually any functional operations described herein.

While particular aspects of the inventive concepts disclosed herein have been shown and described, it will be apparent to those skilled in the art that, based upon the teachings herein, changes and modifications may be made without departing from the inventive concepts described herein and their broader aspects and, therefore, the appended claims are to encompass within their scope all such changes and modifications as are within the broad scope of the inventive concepts described herein.

With respect to the appended claims, those skilled in the art will appreciate that recited operations therein may generally be performed in any order. Also, although various operational flows are presented in a sequence(s), it should be understood that the various operations may be performed in other orders than those which are illustrated, or may be performed concurrently.

I claim:

1. An onboard system for detecting at least one mobile object, the system comprising:

a plurality of image sensors couplable to an exterior surface of an aircraft, the plurality of image sensors configured to generate a plurality of images by scanning at least one spatial region proximal to the aircraft;

at least one visual processor coupled to the plurality of image sensors and configured to:

determine at least one dimension of the at least one spatial region;

detect at least one mobile object within the at least one spatial region based on the plurality of images;

generate targeting data associated with the at least one mobile object based on the plurality of images, the targeting data including at least a target assessment and location data associated with the at least one mobile object; and

send one or more of the plurality of images and the targeting data to at least one visual display system;

the at least one visual display system communicatively coupled to the at least one visual processor and configured to display the one of more of the plurality of images and the targeting data.

2. The system of claim **1**, wherein the at least one visual processor is configured to detect the at least one mobile object based on input provided by a user via the at least one visual display system.

3. The system of claim **1**, wherein the at least one visual processor is configured to determine, based on the plurality of images, one or more of a distance of the at least one mobile object, a target status of the at least one mobile object, an inertial coordinate of the at least one mobile object, and a georeferenced coordinate of the at least one mobile object.

4. The system of claim **1**, wherein the at least one visual processor is configured to determine, based on the plurality of images, a velocity of the at least one mobile object, a heading of the at least one mobile object, and a future position of the at least one mobile object.

5. The system of claim **1**, wherein the at least one spatial region includes at least one of a three-dimensional space proximal to the aircraft and at least one section of terrain proximal to the spatial region.

6. The system of claim **1**, wherein the at least one mobile object includes at least one unmanned aircraft.

7. The system of claim **1**, wherein the plurality of image sensors includes at least one of a visible light sensor, an infrared light sensor, and a stereo pair of image sensors.

8. The system of claim **1**, wherein the plurality of image sensors includes at least

a first image sensor couplable to a first location on the exterior surface of the aircraft, the first image sensor configured to generate a first plurality of images; and

a second image sensor couplable to a second location on the exterior surface of the aircraft, the second image sensor configured to generate a second plurality of images.

9. The system of claim **1**, wherein the at least one visual processor is incorporated into an image sensor of the plurality of image sensors.

10. The system of claim **1**, wherein the at least one visual display system includes at least one of a heads-down display system of the aircraft, a helmet-mounted display system, a head-tracking display system, a multispectral fusion display system, and an offboard mobile device.

11. The system of claim **1**, wherein the at least one visual display system is configured for at least one of picture-in-picture display, digital zoom, and the display of at least one symbol associated with one or more of the plurality of images, the location data, and the at least one mobile object.

12. The system of claim **11**, wherein the at least one symbol includes at least one of a threat assessment, a map detail, an identifier of the at least one mobile object, and a route to a location.

13. A method for detecting at least one mobile object, comprising:

detecting at least one mobile object by scanning a spatial region proximal to an aircraft via a plurality of image sensors attached to an exterior of the aircraft, the plurality of image sensors configured to capture a plurality of images associated with the at least one mobile object;

generating targeting data associated with the at least one mobile object based on the plurality of images via at least one visual processor of the aircraft, the targeting data including at least a target assessment and location data associated with the at least one mobile object; and

displaying one or more of the plurality of images and targeting data associated with the at least one mobile object via at least one visual display system associated with the aircraft.

14. The method of claim **13**, wherein detecting at least one mobile object by scanning a spatial region proximal to an aircraft via a plurality of image sensors attached to an exterior of the aircraft, the plurality of image sensors configured to capture a plurality of images associated with the at least one mobile object includes:

displaying the plurality of images to at least one user via the at least one visual display system; and

selecting the at least one object from the plurality of images based on input from the at least one user.

15. The method of claim **13**, wherein detecting at least one mobile object by scanning a spatial region proximal to an aircraft via a plurality of image sensors attached to an exterior of the aircraft, the plurality of image sensors configured to capture a plurality of images associated with the at least one mobile object includes:

detecting the at least one mobile object by scanning a section of terrain proximal to the spatial region via the plurality of image sensors.

16. The method of claim **13**, wherein generating targeting data associated with the at least one mobile object based on the plurality of images via at least one visual processor of the aircraft, the targeting data including at least a target assessment and location data associated with the at least one mobile object includes:

determining, via the at least one visual processor, one or more of a distance of the at least one mobile object, a target status of the at least one mobile object, an inertial coordinate of the at least one mobile object, a georeferenced coordinate of the at least one mobile object, a velocity of the at least one mobile object, a heading of the at least one mobile object, and a future position of the at least one mobile object.

17. The method of claim **13**, wherein displaying one or more of the plurality of images and targeting data associated with the at least one mobile object via at least one visual display system associated with the aircraft includes:

displaying one or more of the plurality of images and targeting data associated with the at least one mobile object via one or more of a heads-down display system, a helmet-mounted display system, and an offboard mobile device.

18. The method of claim **17**, wherein displaying one or more of the plurality of images and targeting data associated with the at least one mobile object via one or more of a heads-down display system, a helmet-mounted display system, and an offboard mobile device includes:

displaying one or more of the plurality of images and targeting data associated with the at least one mobile object via a head-tracking helmet-mounted display system.

19. The method of claim **13**, wherein displaying one or more of the plurality of images and targeting data associated with the at least one mobile object via at least one visual display system associated with the aircraft includes:

displaying at least one symbol associated with one or more of the plurality of images, the targeting data, and the at least one mobile object via at least one visual display system associated with the aircraft, the at least one symbol including at least one of a threat assessment, a map detail, an identifier of the at least one target object, and a route to a location.

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